APPLIED RESEARCH LABORATORIES

THE UNIVERSITY OF TEXAS AT AUSTIN

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1 October 1997
MJH: ss
TL-SP-97-02

Office of Naval Research
Department of the Navy
800 North Quincy Street
Arlington, Virginia 22217-5000

ATTN: Douglas Lake (Code 1111SP)

Dear Douglas:

Enclosed is the Final Report for Contract N00014-91-J-1276 for the period 1, June 1991 - 31 March 1997, together with two copies of DD Form 250. Please sign and return one copy of the DD250 to Applied Research Laboratories, Attn: Contracts Office.

If you have any questions or need additional information, please contact me.

Sincerely,

Melvin J. Hinich
Signal Physics Group

Encl.

MATERIAL INSPECTION AND RECEIVING REPORT

1. PROC. INSTRUMENT IDEN (CONTRACT)	(ORDER) NO.	6. INVOICE NO.	7. PAGE	OF
N00014-91-J-1276		N/A	1	1
		DATE	8. ACCEPTANCE POINT	
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2. SHIPMENT NO.	3. DATE SHIPPED	4. B/L	5. DISCOUNT TERMS
SPG-0016	1 OCT 97	TCN G	N/A

9. PRIME CONTRACTOR CODE	10. ADMINISTERED BY CODE N66009
Applied Research Laboratories The University of Texas at Austin P.O. Box 8029 Austin, TX 78713-8029	Office of Naval Research Res. Rep. Federal Bldg., Room 582 300 E. 8th St. Austin, TX 78701
11. SHIPPED FROM *(If other than 9)* CODE FOB:	**12. PAYMENT WILL BE MADE BY** CODE N00179
See Block 9	Commanding Officer U.S. Navy Regional Finance Center CM3, Room 206 ATTN: Code 40 Washington, DC 20371-5400
13. SHIPPED TO CODE	**14. MARKED FOR** CODE
Office of Naval Research Applied Research Division, 800 North Quincy Street Arlington, VA 22217-5000	ATTN: Douglas Lake, Code 311

15. ITEM NO.	16. STOCK/PART NO. DESCRIPTION *(Indicate number of shipping containers - type of container - container number.)*	17. QUANTITY SHIP'D/REC'D *	18. UNIT	19. UNIT PRICE	20. AMOUNT
1	Final Report for the Period 1 J une 1991 - 31 March 1997, Continuation of Signal Detection Using Polyspectra TL-SP-97-2 REPORT DISTRIBUTION: 1 copy - ONR RES REP 1 copy - NRL, CODE 2627 2 copies - DTIC	3	ea.	N/A	N/A

21. PROCUREMENT QUALITY ASSURANCE

A. ORIGIN

☐ PQA ☐ ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.

DATE _____ SIGNATURE OF AUTH GOVT REP _____

TYPED NAME AND OFFICE

B. DESTINATION

☐ PQA ☐ ACCEPTANCE of listed items has been made by me or under my supervision and they conform to contract except as noted herein or on supporting documents.

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22. RECEIVER'S USE

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DATE _____ SIGNATURE OF AUTH GOVT REP _____

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23. CONTRACTOR USE ONLY

This is to certify that shipment of the listed item(s) has been made this date 1 October 1997.

SIGNATURE OF ARL:UT CONTRACT OFFICIAL

Final Report for Office of Naval Research
Contract N00014-91-J-1276

Continuation of Signal Detection Using Polyspectra
1 June 1991 - 31 March 1997

Signal Processing Methods

I have developed two methods for detecting and classifying transient signals in a noise background. One uses the third order portmanteau test I presented in "Testing for Dependence in the Input to a Linear Time Series Model," Journal of Nonparametric Statistics (1996). The test statistic is a sum of squared bicorrelations where the number of lags used is a function of the sample size. I have applied the method to real EEG data using a window approach in collaboration with Dr. David Sherman, Biomedical Engineering, Johns Hopkins School of Medicine.

I have written a FORTRAN program which computes the standard second order portmanteau test and my third order test statistic. The second order portmanteau test statistic is the sum of squared correlations of the data in each window for the same number of lags used for the third order statistic. The program also computes the mean, standard deviation, skewness, kurtosis, 6th order cumulant, and range for the data in each window. These statistics along with the portmanteau test statistics are written to a file for graphing. Other summary statistics are computed which helps the user to identify the nature of the transient signals.

The other method I have developed is also being used by Dr. Sherman. I have developed a measure of the phase and amplitude variation of the Fourier components of a signal which repeats from time to time in a noisy background. I define a concept I call "autocoherence" function of frequency and present a method for estimating the autocoherence values from data. I have programmed this method in a FORTRAN program called Spect. I have applied the method to strain gauge vibration measurements taken from a model Lear Jet in the Cornell University Calspan hypersonic wind tunnel. The method and the vibration application is described in a technical paper "A Statistical Theory of Signal Coherence." The Spect program is being implemented in Dr. Sherman's research program.

I am considering the possibility of applying my method to distinguishing direct path sonar reflections from reverberation signals. A sonar pulse which returns from a reverberating layer has a different phase and amplitude structure from a direct path arrival. The partial coherence method can detect subtle differences in the waveform shape from pulse to pulse.

Annual Reports (30 June 1994 - 31 March 1997)

For additional information relative to work performed under this task, the following annual reports should be referenced:

1. "Annual Report for the Period Ending June 30, 1992," Applied Research Laboratories Technical Letter No. 94-04 (TL-SP-94-04), Applied Research Laboratories, The University of Texas at Austin, June 1994 .

2. "Annual Report for the Period Ending June 30, 1993," Applied Research Laboratories Technical Letter No. 94-06 (TL-SP-94-06), Applied Research Laboratories, The University of Texas at Austin, June 1994 .

3. "Annual Report for the Period Ending June 30, 1994," Applied Research Laboratories Technical Letter No. 94-05 (TL-SP-94-05), Applied Research Laboratories, The University of Texas at Austin, June 1994 .

4. "Annual Report for the Period Ending June 30, 1995," Applied Research Laboratories Technical Letter No. 95-10 (TL-SP-95-10), Applied Research Laboratories, The University of Texas at Austin, June 1995 .

Papers Published

1. "Testing For Dependence in the Input to a Linear Time Series Model," Journal of Nonparametric Statistics, **6**, pp. 205-221, 1996.

2. "A Single-Blind Controlled Competition Between Tests for Nonlinearity and Chaos" (with William Barnett, A. Ronald Gallant, Daniel Kaplan, and Mark Jensen), to appear in the Journal of Econometrics (1997).

Technical Meetings and Workshops

Presented my work on signal autocoherence at an ONR workshop on brain research which was held at the University of Florida, May 1996.

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Austin, Texas 78713-8029

SUBJ: DD Form 250

Enclosed are two copies of DD Form 250 as required by DFARS, Appendix F, Distribution for the Material Inspection and Receiving Report. Please sign and return one copy to the address shown above, marked for the attention of the Contracts Office.

A signed DD 250 is necessary for ARL:UT to maintain complete documentation files on the delivery of contractually required items. If you have any questions, please call (512) 835-3299. Thank you for your assistance in this matter.